Issues Pertaining to Catawba Steam Generator Submittal

March 27, 2003

Attachment 2

Previously Identified Tech Spec Issue

- Structural Performance Criteria
- Inspection interval (frequency)
- Tube Repair Criteria

- SG Program Purpose - Editorial

SG Program Purpose - Editorial

Previously Identified Issue

- Keystone requirement: A steam generator program shall be established and implemented to ensure that tube integrity is maintained
- Most details of how the program is to be conducted is outside of tech specs
- Only those few details necessary to ensure public health and safety are included in the tech specs
- Tech spec incorporate performance based approach, not a cookbook for maintaining tube integrity

SG Program Purpose - Editorial

Staff position

- Words in Catawba proposal could potentially be mis-interpreted
- Staff recommendation: see sample tech spec

Structural Performance Criteria

Previously Identified Issue

- Appropriate safety factors for differential thermal loads need to be developed

Structural Performance Criteria

Catawba Proposal

- Supported by White Paper
- Factor of 3.0 and 1.4 would apply only to pressure loads
- All other loads in conjunction with pressure must meet factor of safety of 1.0

Structural Performance Criteria

Status - Staff Review

- Under Review
- Staff expects to issue RAI

Inspection Interval

Previously Identified issues

- General goal - inspection interval
- Frequency of 100% and 50% inspection sample
- Limitation on number of fuel cycles in inspection cycle
- Degradation activity threshold for more frequent inspection

Inspection Interval

Catawba Submittal

- Same general issues
- Proposed degradation activity threshold for cracking, but not other mechanisms

Inspection Interval

Staff Review Status

- Reviewing licensee's response at todays meeting
- Degradation activity threshold criteria needed for non crack-like indications?

Repair Methods

Catawba Submittal

- Would permit repairs without TS amendment
- Acceptable repair methods are those designs in IWA 4720 in Section XI of Code

Repair Methods

Issues

- Staff has not reviewed IWA 4720 as stand alone requirements since Tech Spec requirements control in accordance with 10 CFR 50.55a
- Code requirements do not assure that accident leakage through mechanical joints will be consistent with licensing basis assumptions, that they will be inspectable, and that repairs will not lead to additional severe accident risk
- Tech Spec 40% plugging limit may not be conservative for repairs

Repair Methods

Staff Review Status

- Acceptable repair methods should continue to be controlled by technical specifications.
- Further Code development could support alternative to Tech Spec in future

Emergent Issue

- Background: recent experience (e.g., so called tube sheet inspection issues) highlight importance of ensuring that staff expectations in terms of the minimum actions necessary to ensure tube integrity are clearly spelled out in TS
- The staff has identified changes (see highlighted items in sample TS) which may be needed, in conjunction with 10 CFR 50 Appendix B, to ensure that
  - tube inspection scope and methods are implemented that ensure that all flaws exceeding the tube repair criteria are reliably detected
  - Tube inspection scope, methods, frequency, and repair criteria are implemented such as to ensure that SG tube integrity is maintained

Priority Guideline Issues

- Definition of "burst"
- Objectives - degradation assessment
- Applicable structural performance criteria for wear flaws

- Staff review of Cataba submittal is not contingent on resolution of these items

Sample Tech Specs

- Draft markup; purpose is only to facilitate discussion
- The markups intended to show changes to Catawba proposal which may be acceptable to staff

Sample Administrative Technical Specifications
- Steam Generators with Alloy 600 TT Tubing

5.5.9 Steam Generator (SG) Program

a. A Steam Generator Program shall be established and implemented to ensure that steam generator tube integrity is maintained during operation in Modes 1, 2, 3, 4, ~~and to describe SG condition monitoring, performance criteria, repair methods, repair criteria, and inspection intervals. The Steam generator Program shall address the following topics.~~ **Steam generator tube integrity is maintained by meeting the following tube integrity performance criteria:**

1. Structural Integrity Performance Criteria: **All** steam generator **tubes** shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby and cooldown and all anticipated transients included in the design specification). This includes retaining a safety factor of 3.0 against burst under the normal steady state full power primary to secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident with the largest primary to secondary pressure differential. Apart from differential pressure lods, additional loadings associated with design basis accidents (e.g., bending moments, differential thermal loads), or combination of accidents in accordance with the design and licensing basis, shall be evaluated to determine whether these loads may contribute to burst. **In combination with the associated pressure differential**, contributing loads that do affect burst shall be assessed by **elastic** analysis with a safety factor of 1.0 against burst. *[This criterion is under staff review. The staff may issue RAI.]*

2. Accident Leakage Integrity Performance Criteria: The primary-to-secondary accident induced leakage rate for the limiting design basis accident, other than a steam generator tube rupture, shall not exceed ~~the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed~~ 150 gallons per day (total from all tubes) for any individual steam generator and 600 gallons per day (total from all tubes) through all steam generators.

3. Operational Leakage Integrity Performance Criteria: This criterion is specified in LCO 3.4.13, "RCS Operational Leakage."

b. Condition monitoring assessment means an evaluation of the "as found" condition of the tubing with respect to the structural integrity and accident leakage performance criteria. The "as found" condition refers to the condition of the tubing during a steam generator tube inspection outage, as determined from inservice inspection results or by other means, prior to the plugging of tubes. Condition monitoring assessments shall be conducted during each outage during which the steam generators tubes are inspected, plugged, or repaired to confirm that the structural integrity and accident leakage performance criteria are being met.

c. Periodic steam generator tube inspections shall be performed. The scope of inspection (i.e., the number of tubes and portions of tubes inspected) and method of inspection

shall be such as to ensure the reliable detection of any flaws that are present along the length of the tube, from tube end (hot) to tube end (cold) that may exceed the applicable tube repair criteria. In addition, the scope, method, and frequency of inspection shall be such as **to ensure that the steam generator tube integrity is maintained. In addition,**

1. 100% of the tubes in each steam generator shall be inspected in the first refueling outage following installation.

2. Except as provided for in 5.5.9.c.3, inspect 100% of tubes at sequential intervals of 120, 90, and, thereafter, 60 EFPM. The first sequential interval shall be considered to begin at the first inservice inspection of the steam generators. In addition, inspect 50% of the tubes by the refueling outage nearest the mid point of the interval and the remaining 50% by the refueling outage near the end of the interval. No steam generator can operate for more than 48 EFPM **or two fuel cycles** without being inspected.

3. If a **crack-like indication** is found in any steam generator tube, then the next inspection for each steam generator for the degradation mechanism that caused the crack-like indication shall not exceed 24 EFPM **or one fuel cycle. (If definitive information, such from examination of a pulled tube, indicates that the indication is not associated with crack(s), then the indication need not be treated as crack-like.)** (Note, this item is for presentation purposes only, since sufficiency of this criterion is under active review)

4. (Degradation activity threshold criteria needed for non crack-like indications?)

Extension of these maximum inspection interval requirements through application of Surveillance Requirement 3.0.2 is not permissible.

d. Tube Repair Criteria (i.e., tube plugging limits): Tubes should be plugged (or repaired) such that steam generator tube integrity is maintained for the period of time between inspections. In addition, tubes found by inservice inspection to contain flaws with a depth equal to or exceeding 40% of the nominal tube wall thickness shall be plugged ~~or repaired~~ prior to plant restart (entry into Mode 4).

e. Application of Surveillance Requirement 3.0.3 to this specification is permissible.

Reporting Requirements:

~~If the results of the steam generator inspection indicate greater than 1% of the inspected tubes in any steam generator exceed the steam generator tube repair criteria specified in Specification 5.5.9, Steam Generator Program," a~~ A report shall be submitted within 120 days after the initial entry into MODE 4 following completion of ~~the~~ each steam generator inspection. The report shall include:

a. The scope of inspections performed on each SG.

b. Nondestructive examination techniques used for each degradation mechanism.

c. Location, orientation, and measured sizes (if available) of all indications.

d. Number and location of tubes plugged or repaired during the inspection outage including the reason for plugging/repair.

e. Repair method utilized and the number of tubes repaired by each method.

f. The effective plugging percentage for all plugging and tube repairs in each SG.

g. The results of condition monitoring, including the results of tube pulls and in-situ testing.

h. The planned operating interval until the next inspection

Catawba SG Program LAR

Duke / NRC Meeting
March 27, 2003

Agenda

- Introduction
- Response to NRC Comments
- Future Actions

Introduction

- Duke is committed to the industry's SG Program initiative and to developing the regulatory framework necessary to implement the necessary technical specifications
- The Catawba submittal represents the culmination of over ten years of work by the industry and NRC
- The Catawba LAR includes many significant improvements over the present technical specifications
- Industry is committed to continual improvement of our SG Program and guidelines
- We will continue to work with the staff to resolve technical issues

Introduction

- Industry's efforts on the GLCP has led to the Catawba license amendment request and a TSTF submittal
- Catawba is the lead plant for the industry's SG Program tech spec changes
- Industry's generic changes to the improved standard tech specs (TSTF-449) was submitted on March 14th
- Industry expects a parallel review of the two submittals
  - Subsequent license amendment requests will be based on the TSTF

Response to NRC Comments

- We are responding to comments initially discussed in a March 20th phone call and forwarded by a letter to Duke dated March 24th
- Industry representatives have been consulted in the development of our responses and the positions we will be presenting are representative of the industry at-large

General Goal

- NRC requested that the words "inspection intervals shall be established and implemented to ensure tube integrity is maintained" be added at TS 5.5.9.e
  - We will change the TS as requested

Frequency of Inspections

- NRC requested that the TS include the "frequency of 100% sample inspections and 50% sample inspections as a function of SG age" and tube material "(Alloy 600TT and 690TT only)"
  - We will accept the approach described in TS 5.5.9.c.1 (for Alloy 600TT) and 5.5.9.g.1 (Alloy 690TT) of Enclosure 1 to the NRC's September 9, 2002 letter to NEI (example on next slide)

Frequency of Inspections

- Draft example wording for 600TT tubes:

Except as provided for in 2., inspect 100% of tubes at sequential intervals of 120, 90, and, thereafter, 60 EFPM. The first sequential interval shall be considered to begin at the first in-service inspection of the steam generators. In addition, inspect 50% of the tubes by the refueling outage nearest the mid point of the interval and the remaining 50% by the refueling outage near the end of the interval. Each steam generator shall be inspected every two refueling outages or 48 EFPM, whichever is less.

Cycle Limitations

- NRC requested that refueling cycles as well as EFPM be used to limit SG inspection intervals
  - Our draft changes the words fuel cycles to refueling outages to maintain consistency with the Exam Guidelines
  - We will accept the approach described in TS 5.5.9 of Enclosure 1 to the NRC's September 9, 2002 letter to NEI with the change noted on the previous slide

Degradation Activity Threshold

- NRC requested that inspection intervals be limited to 24 EFPM or once per cycle if a tube's degradation activity threshold is exceeded
  - We propose an approach consistent with that described in Rev 6 of the SG Examination Guidelines
    - Using our definition of active damage mechanism and
    - Allowing use of the operational assessment

Degradation Activity Threshold

(Rev. 6 Appendix F.1) Active Damage Mechanism:

A combination of 10 or more new indications (≥ 20% through-wall) of thinning, pitting, wear (excluding loose part wear), or impingement and previous indications that display an average growth rate equal to or greater than 25% of the repair limit in one inspection-to-inspection interval in any one steam generator,

One or more new or previously identified indications (≥ 20% through-wall) which display a growth equal to or greater than the repair limit in one inspection-to-inspection interval, or

Any crack indication (outside diameter intergranular attack/stress corrosion cracking or primary-side stress corrosion cracking).

Degradation Activity Threshold

- Revision 6 allows the operational assessment to be used as the basis for establishing inspection intervals for damage mechanisms not associated with cracking

Degradation Activity Threshold

- We do not agree with the NRC's definition of degradation activity threshold for two reasons
  - The use of degradation activity threshold does not allow for the operational assessment to adjust cycle limitations due to damage mechanisms not associated with cracking
  - The definition of degradation activity threshold treats loose parts inappropriately

Degradation Activity Threshold

- Operational Assessment
  - Some degradation mechanisms are well understood and can be measured with sufficient accuracy to allow extended inspection intervals as long as they are supported by an operational assessment
  - In these cases, use of the operational assessment should be allowed by the technical specifications

Degradation Activity Threshold

- Loose parts
  - Loose parts can find their way into the SG at any time during operation. Due to the unpredictable nature of their occurrence, adjusting inspection intervals based on loose parts is not appropriate.
  - Loose parts are a concern for other components within the primary system and detailed analysis for these components are not specified in the tech specs
  - Loose parts evaluations are part of Rev 6 of the SG Examination Guidelines.
  - Loose part wear evaluations are included in the operational assessment.
    - Rev 6 includes requirements for secondary side visual inspections
    - The current requirements in the integrity guidelines are being revised to increase the emphasis on the need to evaluate foreign object wear and its effects on inspection intervals

Structural Performance Criterion

- Industry has worked with NRC Staff since 1998 to develop a structural performance criterion. The latest industry criterion was incorporated in the Catawba submittal
- Technical Basis and Philosophy of Structural Performance Criterion
  - RG 1.121 used as historical reference
    - Not a design or licensing basis
  - Consistent with ASME Section III Design Margins
    - ASME Section XI applies to in-service/degraded components
  - Provide criteria/margins that are verifiable through Condition Monitoring
    - In Situ Pressure Testing and Analysis
    - Definition of Burst
  - Terminology made consistent with Technical Specification/UFSAR
  - Original NEI White Paper submitted to NRC June 1999
    - Revision submitted to NRC November 2002

Structural Performance Criterion

Steam generator tubing shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cooldown and all anticipated transients included in the design specification) and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst for the largest primary-to-secondary pressure differential associated with Level D service. Additional conditions identified in the design and licensing basis shall be evaluated to determine if the associated loads contribute significantly to burst. Contributing loads that do affect burst shall be assessed with a safety factor of 1.0 and combined with the appropriate load due to the defined pressure differential.

*** Bold print represents change from NEI 97-06 Rev 01**
Basis for changes documented in NEI White Paper

Structural Performance Criterion

- **Previous** - "*...safety factor of 1.4 against burst under limiting design basis accident*"
- **Change** - "*...safety factor of 1.4 against burst for largest primary-to-secondary pressure differential associated with Level D service.*"
- **Reason** – Establishes level D events for the evaluation following RG 1.121 guidance. Corrects the ties to ASME Section III margins. Some design basis events are characterized as ASME Level C for which safety factor of 1.4 does not apply. Ties safety factor to original design basis/specification.
- **NRC Comment** - concern that Catawba application of safety factors of 3.0 and 1.4 depart from design basis (ASME Section III, GDC-2, RG 1.121)

Structural Performance Criterion

- **Industry Response –**
  - No change in application of 3.0 safety factor.
  - Change to 1.4 safety factor application is consistent with ASME Section III, despite the fact that ASME Section III is not specific to in-service steam generators.
  - RG 1.121 not part of Catawba design basis - however the performance criterion wording is consistent with historically accepted applications of the RG.
  - The performance criterion satisfies GDCs 1, 2, 4, 14, 30, 31, 32 with respect to tube integrity.

Structural Performance Criterion

- **Previous** - "*Any additional loading combination shall be included as required by existing design and licensing basis.*"
- **Change** - "*Additional conditions identified in the design and licensing basis shall be evaluated to determine if the associated loads contribute significantly to burst. Contributing loads that do affect burst shall be assessed with a safety factor of 1.0 and combined with appropriate load due to the defined pressure differential.*"
- **Reason** - First sentence represents clarification only not a change. Second sentence added to define safety factor for additional loadings consistent with ASME Section III for secondary loads and ASME Section XI flaw evaluation procedures

Structural Performance Criterion

- **NRC Comment** - Safety factor of 1.4 should apply to combination of accident conditions (i.e., MSLB +SSE or LOCA+SSE).
- **Response** –
  - The SSE loads are insignificant contributors to burst in most locations. SSE loads result in bending stresses, which, when included in a Code evaluation, result in an allowable margin of 1.0
  - Some plants do not include SSE loads in their design basis
  - The treatment of secondary loads is consistent with ASME Section III.
  - Historically, the Staff has accepted MSLB without SSE.
  - The performance criterion must be verifiable in the field during SG inspections.

Repair Methods

- NRC is concerned with our proposal to allow use of repair methods specifically included in the ASME Code
  - We accept the NRC comment based on the statement that the NRC's approval of the ASME Code repair methods assumed that the methods were also dictated by the tech specs
  - We request that this approach be considered in the NRC's endorsement of future Code changes

Previously Identified Priority Guideline Issues

- NRC expressed the need to resolve SGMP Guideline issues regarding degradation assessments and the definition of burst
  - NRC and industry have previously agreed that these are technical issues that will be resolved outside of the SG Program generic license change process
  - Industry and NRC have agreed on a protocol for dealing with these issues and have developed a means of prioritizing them and tracking them to completion
  - Industry agreed in our September meeting that we would enhance our guidance in these areas and the revision of the integrity assessment guidelines currently being prepared is dealing with these issues.
  - Per our previous agreement, resolution of these items should not hold up the technical specification changes

Emergent Issues

- NRC has not identified the specific issues that fall within this area
- It is our understanding that all issues have been identified and are being resolved

Future Actions

- Catawba has requested a fee waiver for their submittal. One has been given to all the GLCP submittals to date.
- Catawba will submit a revised LAR to incorporate the changes agreed to at this meeting
- The TSTF will also be revised accordingly